

STIMSON (L.A.)

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BY

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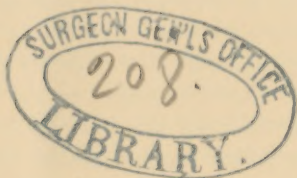
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AN INQUIRY INTO THE ORIGIN OF THE  
USE OF THE LIGATURE;  
IN THE TREATMENT OF ANEURYSM.\*

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AMONG the many great advantages modern methods of treating wounds have conferred upon the art of surgery, one of the greatest is the security they have given to operations upon the arteries. They have made it possible to tie the principal arteries of the limbs in continuity with almost absolute security against secondary hæmorrhage, and with greatly diminished risk of causing gangrene. They have almost entirely done away with, or have relegated to the class of exceptions, that host of alternative methods by which for a century surgeons have sought to replace the ligature in the treatment of external aneurysms. It has become so safe to tie the femoral artery, for example, that the surgeon who, in an ordinary case of popliteal aneurysm, should resort to that operation in preference to any other method, would not be deemed indifferent to his patient's best interests, or thought to have exposed him to any serious risk which might have been safely avoided. The effi-

\* Read before the New York Surgical Society, October 14, 1884.

ciency, promptness, and painlessness of the method would be accepted as a complete equivalent for the advantages peculiar to such rival methods as digital pressure or the use of the elastic bandage.

Such being the case, the question of priority in the introduction of the ligature gains in interest, and it is to that question that I ask your attention—a question that has been made to turn, not upon the simple fact of priority in the use of the ligature (concerning which there is no obscurity), but rather upon the motives, principles, and knowledge that guided those who first used it and who established the method. The facts are as follows:

On the 30th of January, 1710, Dominique Anel, a French surgeon practicing in Rome, operated upon a priest for a very large aneurysm of the brachial artery at the bend of the elbow, caused by an unskillful venesection; he exposed the artery above the tumor, and tied it as close to the latter as was possible; the patient made a good recovery.

The report of the case provoked much discussion, and a spirit hostile to Anel and to the new method showed itself in the country of his adoption, and it was charged against him, with a variety that testifies to the ingenuity of his detractors, that the case was not an aneurysm, that he had not cured it, and that the cure was only by a lucky chance. Against the first two charges he brought the written testimony of other surgeons who had seen the case; and against the third he offered arguments which show his correct apprehension of the manner in which the operation effects a cure. He says: "I did not touch the sac at all, not doubting that the blood would leave it, since the way was open for it to pass down the limb, and that the sac, once emptied, would not refill; that the tissues of the membranes which formed it would not fail to shrink, and that



thus the tumor would disappear; which did not fail to take place as I had expected." \*

The case, together with his reply to various criticisms, was published by Anel in 1714, and the account was republished in various journals and books in 1716, 1739, 1749, and 1750; and the operation appears to have been repeated three times upon the brachial artery and once upon the temporal; in one of them the artery was tied "on the inner side of the arm above the condyle"; in all the aneurysm was traumatic.

The question at once arises: Why was not this method at once accepted by the profession and generalized? The answer is to be found, I think, in the attitude of the profession toward aneurysms in general, and in the ignorance of the existence of the collateral circulation. At the time Anel operated, surgeons attempted the cure only of traumatic aneurysms of the brachial and temporal arteries following venesection; against popliteal and femoral aneurysms they knew of no resource except amputation of the limb, and they had yet to learn even that the femoral artery could be tied without causing gangrene of the limb. One man (Morel, 1687) had applied the old method to a carotid aneurysm, but his patient died on the table, and the case served as a warning, not as an encouragement. The old method of laying open the sac and tying all bleeding points

\* "Car au lieu que l'on a accoutumé de faire la ligature en haut et en bas de l'anevrisme, je ne la fis, dit il, que du côté du haut: d'ailleurs, on ouvre le sac anevrismal, et je ne l'ai point touché du tout, ne doutant pas que le sang contenu dans ce sac ne se dissipât, ayant la liberté de se porter du côté de l'extrémité, et que ce sac étant une fois vuide, ne se rempleroit plus de nouveau, que les tuniques des membranes qui le formoient, ne manqueroient pas de s'affaïsser, et qu'ainsi la tumeur devoit disparaître, ce qui n'a pas manqué d'arriver de même que je l'avois pensé."—Trévoux, January, 1716, p. 163; reprinted in "Bibliothèque choisie de méd.," 1749, vol. ii, p. 472, art. "Anévrisme."

could be practiced without much difficulty and very successfully upon these minor aneurysms, and, although Anel's method recommended itself as easier of execution, it was, on the other hand, less certain to cure, because many of these aneurysms were arterio-venous aneurysms, and persisted or recurred after ligature of the artery. In two of the four cases above mentioned the disease returned, probably for this reason. In short, as regards some of the cases with which the surgeons of that time had most frequently to deal—arterio-venous aneurysms at the elbow—they possessed and successfully practiced the operation which to-day is still used in similar cases; and as regards the others, traumatic aneurysms of the brachial and temporal arteries, the same method was efficient; and, although the offered substitute was simpler, this advantage was offset by its failure when the aneurysm was arterio-venous; and they did not recognize the cause of the failure, for they had not learned to discriminate between this variety (first described by William Hunter in 1757) and the ordinary aneurysm. They labored under no embarrassment, no great difficulty from which his operation could relieve them; it even exposed them to a variety of failure which they had not before known—the persistence or recurrence of the disease—and their knowledge of the resources of nature was not sufficient to enable them to extend their field of operation. What wonder that the new system was neglected and forgotten!

During the following half-century surgeons learned that it was not necessary to amputate the leg of a patient because the femoral artery was wounded; ligature of the wounded artery had been successfully practiced as early as 1646, and again in 1688, but it was not formally proposed as a substitute for amputation until nearly a century later. And, at about the same time, the "old operation" was first employed in a case of popliteal aneurysm successfully (Keys-

lère, 1744), and, twenty years later, again successfully for femoral aneurysm (Burchell, 1765).

The attention of surgeons was now fully directed to the treatment of spontaneous aneurysms of the lower extremity, to the search for a proper substitute for the amputation which before had been the only resource. The first substitute was to extend to them the old operation, to repeat in a somewhat modified form what had been done by Antyllus more than fifteen hundred years before. Papers were written to prove that the obliteration of the artery would not cause the limb to fall into gangrene, and experience by actual operation rapidly accumulated.

The results of that experience were far from satisfactory. Pott ("Surgical Works," edited by Earle, vol. iii, p. 220) says of this operation: "I have tried it myself more than once or twice—I have seen it tried by others; but the event has always been fatal. . . . Nor have I ever seen any other operation than that of amputation which has preserved the life of the patient"; and, as Mr. Holmes points out, the immediate success of the treatment of popliteal aneurysm by proximal ligation (the "Hunterian" method), which itself has a mortality equal to that of amputation of the thigh, shows that the mortality after the old operation must have been something frightful. Something better needed to be found, and the times were growing ripe. Men were beginning again to think; the long blank period of tradition and dogmatism was coming to an end, and men stood at the threshold of the new era in which, under the influence of the intellectual upheaval of the French Revolution and the leadership of the French physicians, medicine was to become a science based on objective knowledge.

It had been learned that a popliteal or a femoral aneurysm could be cured by opening the sac and tying the artery above and below, but that the operation carried with it an



enormous risk of death by secondary hæmorrhage and the accidents arising from a large, irregular, suppurating wound. And, in describing the operation as incision of the sac and ligature of the vessel, it must be remembered that this order was frequently reversed and the artery tied before the sac was opened; the object was a double one: to close the vessel and to empty the sac, and the order in which these objects were attained was immaterial.

Desault's first operation of ligature on the proximal side was done June 22, 1785, and Hunter's December 12th of the same year; but nine years before this, 1776, Desault \* had had an opportunity to dissect a specimen of popliteal aneurysm that had undergone spontaneous cure, and he had found the popliteal artery plugged by clotted blood, the femoral obliterated "as far up as the origin of the muscular branches," and likewise the upper third of the tibial arteries. An Italian surgeon, Assalini, who spent a year in Paris, and a few months subsequently in London, and had the good fortune to see both Desault's and Hunter's operations in 1785, published a book † in 1787 in which he reports Desault's teaching in 1785; referring to this dissection of 1776, he says he [Desault] thought the obliteration of the upper and lower portions of the artery was the result of the stagnation of the blood in them, produced by plugging of the aneurysm, and that for this reason, in the treatment of true aneurysms of large vessels, he did not apply two ligatures and did not open the sac; he placed a single ligature above the aneurysm if that was possible, or below it if the condition of the parts made that necessary. By this simple ligature he prevented the blood from entering the sac and circulating in the dilated vessels.

\* Broca, "Des anevrysmes," p. 449, from "Journal de méd." (Vandermonde), vol. lxx, p. 473.

† "Essai médical sur les vaisseaux lymphatiques," Turin, 1787.



This report is the substance of a clinical lecture given by Desault at the time of his first operation. It shows his conception of the method of spontaneous cure and of the means by which that method could be imitated; he sought to obtain coagulation of the blood through arrest of the current by placing an obstacle on either the proximal or distal side, and he knew—he had known for nine years—that it was not necessary to turn out the clots, that the incision of the sac could be dispensed with if the artery could be otherwise closed. But how was that to be done? Naturally enough, he first tried compression, and, that failing, then the ligature in continuity. Broca tells us that the first case of which we have knowledge that came under Desault's care was an axillary aneurysm, shortly before February, 1785, and he attempted to treat it by compression of the subclavian artery. Ligature of the subclavian was at that time an unknown operation. For some reason the patient left Desault and put himself under the care of another surgeon, who mistook the tumor for an abscess and opened it.

The idea of compression of the artery above the tumor was not new or unknown. In 1761 Kretschmer treated a traumatic aneurysm, resulting from a gunshot wound of the brachial artery, by direct pressure upon the tumor and by a tourniquet on the lower portion of the axillary artery; the latter was kept in place for three months, and the patient was completely cured. In 1765 Guattani treated a popliteal aneurysm by a bandage applied directly to the leg and tumor, and to the thigh over a long, narrow pad, placed along the course of the femoral artery, with the expressed intention of preventing, wholly or in part, the flow of blood to the tumor. And again, in September, 1785, at a consultation, held in London, on a case of femoral aneurysm as large as a middle-sized China-orange, at which eight surgeons (of whom Hunter was one) were present, all “were

convinced of the impracticability of affording the patient any assistance by the operation usual for aneurysms," and advised that the artery should be compressed at the groin; the attempt was made, but soon abandoned, because of the pain.\*

We are now able to understand the position of the profession at the time; we know the extent of their knowledge, and with what problems they were dealing; we can put ourselves in Desault's place, interpret his act, and comprehend his motives. Let us see if that act was, as the partisans of Hunter claim, merely a lucky blunder, conceived in ignorance and passed without appreciation.

Desault knew an aneurysm could be cured without an incision to turn out the clot; he knew, as did most other surgeons, that the femoral artery could be tied without causing gangrene. He knew also that the principal cause of death after the common operation was secondary hæmorrhage, and the avoidance of this danger was his principal preoccupation, as it was also that of Hunter. We have seen that, far from trying to get rid of the clot, he sought to cause clotting, and at the same time avoid hæmorrhage, by compressing the artery on the proximal side. The attempt failed, presumably because of pain, and, when the next case came under his care, he substituted the ligature for compression.

The operation was done June 22, 1785, at the Hôtel Dieu in Paris. The patient was thirty years old; the aneurysm, of the popliteal artery, was as large as a turkey's egg. By an incision two inches long, Desault exposed the artery "immediately below the ring of the third adductor," separated it from the nerve, and tied it; he placed also a *ligature d'attente* above it, and tied this on the sixth day. The

\* "London Medical Journal," 1788, p. 149. "Cases of the Spontaneous Cure of Aneurysm," by Mr. Edward Ford.

tumor promptly diminished to half its size, and the œdema of the leg disappeared. On the eighteenth day the ligature came away, and on the following day a large quantity of pus and blood escaped through the wound, apparently in consequence of rupture of the sac, and the wound then healed.

Desault operated upon only one additional case; this was shortly after Hunter's first case, and Desault, following Hunter's example, which was known to him, placed the ligature on the femoral artery, but at a still higher point. The patient died.

There remains now to be considered only the part taken by Hunter in the introduction of the ligature. We have already seen that in September, 1785, three months after Desault's operation, he had nothing to suggest in the treatment of a femoral aneurysm as large as a medium-sized orange, except compression of the artery in the groin, and that this was unsuccessfully tried. Three months later, December 12, 1785, he tied the femoral artery for a popliteal aneurysm.

The case was reported by Everard Home, in the "*London Medical Journal*," 1786, p. 334, and again, with four similar operations done by Hunter and three by others, in "*The Transactions of a Society for the Improvement of Medical and Surgical Knowledge*," London, 1793, p. 138. The date of the reading of the latter paper is not given, but that of the one that precedes it is September, 1789, and that of the one that follows it is September, 1790. The second account is almost a literal transcript of the first. I quote from the second:

The patient was a coachman, forty-five years old, and the aneurysm "was so large as to distend the two hamstrings laterally and make a very considerable rising between them. . . . The operation was begun by making an incision

on the anterior and inner part of the thigh rather below its middle, which incision was continued obliquely across the inner edge of the sartorius muscle, and made large, to give room for the better performing of whatever might be thought necessary in the course of the operation. The fascia which covers the artery was then laid bare about three inches in length, after which the artery was plainly felt. A slight incision, about an inch long, was then made through this fascia, along the side of the vessel, and the fascia dissected off; by this means the artery was exposed." A double ligature was passed around the artery [and vein] and "cut so as to form two separate ligatures. The artery was now tied by both these ligatures, but so slightly as only to compress the sides together. A similar application of ligature was made a little lower. The reason for having four ligatures was to compress such a length of artery as might make up for the want of tightness, it being wished to avoid great pressure on the vessel at any one part." [A fuller explanation of this practice is given in an earlier sentence (p. 145) as follows: "The cause of failure arises from tying a diseased artery, which is incapable of union, in the time necessary for the separating of the ligature." Apparently, Hunter thought that by tying the artery loosely more time would be given for the artery to become sealed before the ligature cut through. Certainly his intention was not simply to diminish the stream, for the ligatures cut through, and in his subsequent operations he used a single ligature and tied it tightly.] Secondary hæmorrhage occurred on the ninth day, but was controlled by a tourniquet: "on the fifteenth day some of the ligatures came away, followed by a small discharge of matter, the tumor in the ham being lessened." In April, and again in July, more of the ligatures came away, and on July 8, 1786, he was discharged cured. April 1, 1787, fifteen months after the operation,



he died of remittent fever. His following four operations were similarly performed, except that in the fourth and fifth the artery alone, and not the vein, was tied. The second died of secondary hæmorrhage on the twenty-sixth day.

This is followed by the account of three operations performed after the same method by other surgeons, of one of which, by Pott, he says: "*This mode of operating* \* was adopted by Pott in a case of popliteal aneurysm," and he goes on to describe how the artery, probably the popliteal, was exposed by "an incision five inches in length, upon the posterior part of the thigh . . . between the two hamstrings"; and he adds (p. 173): "The mode of taking up the artery in the ham must be always unfavorable to the future success of the operation, if either the artery itself should be diseased, or if the tumor, by being so contiguous to the violence done in the operation, should be affected by the consequent inflammation, which seems to have been the case in Mr. Pott's operation, as I understand two abscesses were found close to the sides of the sac." Here is the same operation as that done by Desault (ligature of the popliteal artery) and quoted by Home, in the first authorized account of Hunter's method, as an example of Hunter's method, and this in itself would be sufficient, even if it were not corroborated again and again in the article, to show that Hunter's only idea was to tie the artery without opening the sac, and the reason he gives for tying it at a somewhat higher point (two inches at the most) than Desault and Pott did is ("London Medical Journal," and repeated by Home, *loc. cit.*, p. 146) that, "if the artery should afterward [after ligature of the popliteal] give way, there will not be a sufficient length of vessel remaining to allow of its being again secured in the ham. To follow the artery up through the insertion of the triceps muscle,

\* Italics mine.

to get at a portion of it where it is found [? sound], becomes a very disagreeable part of the operation; and to make an incision upon the fore part of the thigh, to get at and secure the femoral artery, would be breaking new ground—a thing to be avoided, if possible, in all operations.” In one of the remaining two cases, a femoral aneurysm, extending to within two inches of Ponpart’s ligament, Mr. Cline tied the artery *half an inch below* the origin of the profunda, and, as the dissection showed, two inches above the orifice of the sac. This also is given in illustration of the method, and yet there could have been no collateral branches between the ligature and the sac; certainly none are mentioned.

In short, his one idea was to avoid secondary hemorrhage by tying the artery at such a distance from the aneurysm that it would probably be found healthy, and to make the application of a second ligature easy if such hemorrhage should occur. Of the “excogitation of a principle by profound reasoning,” of which Mr. Holmes speaks, there is not a trace in this account; of the second “great merit” attributed to him by the same able writer, “that it was not necessary to stop the circulation through it [the sac] absolutely, but only,” as he said, “to take off the force of the circulation,” there is no justification except this quoted phrase, which, in view of the fact that the ligatures divided the artery completely, although, perhaps, more slowly than if they were tied tightly, certainly can not have the meaning attributed to it of only diminishing the stream of blood, and which, even if it did, was abandoned after the first operation, when he substituted a single ligature tied tightly for four ligatures tied loosely.

Moreover, the idea of curing an aneurysm by simply diminishing the flow of blood through it was by no means new; it underlay all the preceding attempts to cure by

compression, and was plainly included in Desault's lecture reported by Assalini and quoted above. It was not until after the ligature in continuity had shown that the danger of secondary hæmorrhage was still present that very forcible compression, to effect complete and permanent closure of the artery, was tried as a substitute for the ligature.

The three grand merits claimed for Hunter (Holmes's "System of Surgery," art. "Aneurysm") are that he had seen: 1. That it was not necessary to turn out the clots; 2. That it was not necessary to stop the circulation through the sac absolutely, and that, therefore, the artery might be tied at some distance above it; and, 3. That the ligature of the main artery would not involve gangrene of the limb. Now, of these, the first was certainly known by Desault, through a post-mortem examination, and probably by most other surgeons, as is proved by their attempts to cure by compression. As regards the second, the fact contained in the first clause, that it was not necessary to stop the circulation completely, had been long known before his operation; and the inference stated in the second clause was not drawn by Hunter, and was not given as his reason or justification for placing the ligature at a higher point. Home's paper (which, it must be remembered, is an official one, and made in Hunter's name) does not contain a single reference to collateral branches given off between the ligature and the aneurysm.\* The phrase "that simply taking off the force of the circulation is sufficient," which is also quoted as meaning that a diminished stream of blood was expected

\* The only reference to collaterals in the first paper is one (p. 399) to the effect that "surgeons have laid too much stress on the necessity of large collateral branches being present to insure the success of this operation, . . . since we find that the trunk of the femoral artery may be taken up in any part of the thigh without producing mortification of the limb."

to be brought to the aneurysm by collaterals, is the only thing in the entire paper that can suggest such an idea; and that neither this meaning nor the one above referred to—of only partly compressing the artery—was intended to be conveyed by it, is shown not only by actual statement of the reasons and objects of the operation, but also by a case which he quotes (p. 156) in illustration of his argument—a case of spontaneous cure of an aneurysm by inflammation of the sac, accompanied by arrest of pulsation in the sac and in the artery immediately above it. If the phrase were written out in full to express the entire idea, it would read: “It is sufficient simply to take off the distending force of the arterial stream from the blood contained within the aneurysm; the blood will then coagulate in the sac and in the adjoining part of the artery, and the progress of the disease will be stopped; it is not necessary to open the sac.”\* The opening of the sac is what he was thinking of when he used the word “simply,” not of the presence or absence of collateral branches, not of merely diminishing the stream.

\* Compare the corresponding paragraph in “London Medical Journal,” letter of Home, November, 1876, p. 393.

“From these considerations [those quoted above about the desirability of not breaking new ground], suggested by the accident of the artery giving way, which happened several times to Mr. Hunter, he proposed, in *performing this operation*, that the artery should be taken up at some distance from the diseased part, so as to diminish the risk of hemorrhage and admit of the artery being more readily secured, should any such accident happen. *The force of the circulation being thus taken off from the aneurysmal sac, the cause of the disease* would, in Mr. Hunter’s opinion, be removed; and he thought it highly probable that, if the parts were left to themselves, the sac, with the coagulated blood contained in it, might be absorbed, and the whole of the tumor removed by the actions of the animal economy, which would consequently render any opening into the sac unnecessary.” [Italics mine.]



The third great merit—that Hunter saw that the ligation of the main artery would not involve gangrene of the limb—had been known for a hundred years, and had been proved by every successful case in which the old operation had been used, and also by Desault's ligature in continuity six months before.

Both Desault and Hunter had the same object in view : to cure the aneurysm without opening the sac. Desault had a small aneurysm, and tied the popliteal at its upper end. Hunter had a large one, and tied the artery a little higher up (he could not well have done differently). Desault, in his second operation, went still higher, and tied a little below the apex of Scarpa's triangle ; subsequent operators have habitually tied in the triangle itself. Even the observation claimed for Hunter—that the artery was diseased above the aneurysm, and that this was the cause of the secondary hæmorrhage—had been made before him, and was given by Pott as a reason for preferring amputation to the old operation (Pott, *loc. cit.*, p. 220).

I see nothing in Hunter's operation radically to differentiate it from Desault's and to justify the ascription of the method to the English surgeon. It seems to me to be beyond question that Desault had grasped the principle, and the difference of an inch, or two or three or six inches, in the distance, is a matter of detail which is to-day subordinated to the rule that the artery should be tied at the nearest accessible point that does not directly involve injury to the sac.\*

\* It seems unnecessary, in view of these facts, to consider the question, whether or not Hunter knew of Desault's operation before performing his own. The facts bearing upon it are, that Assalini was at Desault's operation, afterward went to London, and was present at Hunter's operation, and that Hunter, three months before his operation, seems to have made no suggestion of this treatment in the case of

Why Hunter's name should have become so pre-eminently identified with it is to be explained by reasons entirely independent of the principle involved, and of the measure in which that principle was grasped by the two great rivals. Hunter enjoyed a great authority and was widely known; his example was followed, his practice was quoted by those who wrote in our language. Desault lived and made his great discovery at a time when his nation was entering upon a revolution that shook the world and isolated France by war for nearly twenty-five years; he made it at a time when men were occupied with mighty interests beside which the advances of science seemed as nothing; at a time when, to Lavoisier pleading for another fortnight of life that he might complete certain experiments, the answer was: "The Republic has no need of such." What wonder that at such a time and amid such surroundings his discovery should have passed unheeded by those about him, and have remained unknown by those who were at war with his country? It is our privilege, our duty, to recognize his work and to give him the credit that is his due.

femoral aneurysm, quoted above, which he saw in consultation, and which, after a futile attempt at cure by compression, was abandoned to its fate.

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